RICE UNIVERSITY

Lions, Tigers, and Bears, Sky High!

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ABSTRACT

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The vertical zoo is a new zoo typology that rethinks both the organizational strategy of the traditional urban zoo and the tower building typology. By stacking the exhibits vertically the zoo program pushes exhibit organization in a new direction, providing opportunities for experiences not possible in traditional urban zoos. In addition, vertical stacking of the program is more efficient, taking advantage of the characteristic behaviors of heat, water and light to guide exhibit group organization. Furthermore, the verticality of the zoo program enables the zoo to become a more visual presence in an already dense urban environment. The new spatial organization of the zoo is accomplished through a reconfiguration of the systems integral to a traditional tower: the centralized core, the repetitive floor plate, and the nonspecific skin system.
ACKNOWLEDGEMENTS

To Greg, without whom this would have been impossible.

To my director, Clover Lee, who’s support and dedication and patience meant everything to the development of this project.

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Modern society lives on top of nature.
Charlene Spretak

Zoos are urban institutions. Originally parks on the city edge urban dwellers could visit when city life became overwhelming, it was a but a short time before zoos were enveloped in rapidly sprawling urban development.

For centuries zoos have provided unique opportunities for education, entertainment and research not found elsewhere in urban centers. In the last century, as knowledge of the natural kingdom changed and grew, zoos responded. Owned and operated by municipal governments, the initial responses of zoos to change were conservative. Today zoos are operated by private and not-for-profit companies and must compete for money and attention within urban and suburban settings. To woo visitors, zoos are changing in ways more radical than ever, creating and simulating entire environments into which the zoo visitor is immersed.
Situated in an extremely dense urban environment, the vertical zoo examines how the most successful exhibit type to date, the immersion exhibit, can continue to push the evolution of the zoological institution through stacking.
The history of the zoo: 3 exhibit types

How zoos have changed in time is reflected through the evolution of the exhibit typology. Exhibit evolutions are systemic and alter the zoo at three scales:

1. the specific exhibit
2. the grouping or organization of multiple related exhibits
3. the organization of exhibit groups on the scale of the zoo itself.

In the thousands of years that zoos have been urban institutions, there have been to this time only three polemical shifts in the evolution of the exhibit typology.
(1) **Elevational exhibit**

The first milestone, the elevational exhibit, occurred in 1828 with the opening of the London Zoo. The elevational exhibit is defined by the perception of the exhibit through its frontal elevation. This scheme originally placed animals in a neutral environment, separated from the observer by an obvious barrier (i.e. iron bars or a visible moat). In the elevational exhibit scheme the animal and the observer have a one-to-one relationship. Elevational exhibits were often arranged linearly and according to taxonomy. These exhibit groups were further arranged according to animal family similarities.
The London Zoo opens in Regent's Park. The world's first Zoological Gardens, the London Zoo was predicated on creating a scientific establishment for "teaching and elucidating zoology, and no public menageries..." (Hancocks)
2. **Perimeter exhibit**

The second milestone, the perimeter exhibit, first opened in the late 1960's. This exhibit type did not replace the elevational exhibit but was added to the repertoire of zoo exhibit types. Like theater in the round, this type of exhibit enables observers to view animals from several different perspectives located around the exhibit enclosure, with views from above, below, over or under.

This scheme places pairs or small groups of animals in a naturalistic setting either indoors or out, separated from the observer by artifice and invisible barrier such as height or hidden electrical wire. In many cases perimeter exhibits were and are arranged according to country of origin. Groups of exhibits arranged by country of origin are often further organized with complimentary climatic zones adjacent to one another.
1976

Public outcry demanded zoos modernize their animal environments and veterinary care, or close their doors for good.
3 Immersion exhibit

In the early 1990's, the immersion exhibit scheme was added to the zoo exhibit catalog. The focus of the immersion exhibit is to recreate the natural setting and behavior of the animal inhabitants. Different from the previous two exhibit schemes, the immersion scheme locates the observer within the animal enclosure, looking outwards to the animal and exhibit borders beyond. The scheme places typical species groups in a setting reliant upon both natural and artificial ground condition and vegetation, again separated from the observer artifice and invisible barriers.

Similar to the perimeter scheme, immersion schemes are typically arranged according to country of origin, but require a larger area than the previous exhibit types. Space permitting the immersion scheme may occur in either an indoor or an outdoor setting.
1992

Successful animal enclosures must possess the essence of the equivalent wild habitat.

Of the exhibit types, the immersion exhibit scheme has been the most successful based on the following criteria:

1. animal health and welfare,

2. providing the zoo visitor with an experience that is entertaining and completely engaging,

3. and providing an educational experience, enabling the visitor to observe animals behaving in as natural a way as possible in an urban environment.

However, this model of immersion exhibit is difficult to implement in dense cities because of its large area requirement.
Zoo in the city

Most zoos rely on nothing but a very thin line of park space to both delineate and protect the zoo from its urban environment. This thin park line also means the zoo has little to no room to grow outwards and thus must seek other ways in which the immersion exhibit experience can be provided.

While the north and east edges of the zoo are buffered by the Parc de la Ciutadella, the south and west edges are bounded by the neighborhood, La Vila Olímpica. A 4m stone fence and zoo exhibit buildings are the only barriers between the zoo and the adjacent urban environment. The audio and visual presence of the city is apparent continuously along the eastern edge of the zoo.
Zoological networks

Many zoos have specialized and institutionalized into zoological networks in order to find the space that enables the network now, instead of the independent zoo, to provide the full immersive experience. The network is composed of newer zoo typologies that function alongside the traditional urban zoo:

- the wild animal park
- the regional park
- the endangered species park
- and the aquarium.

These zoological institutions are then united to form zoological networks, examples include CRES (Conservation and Research of Endangered Species) that includes the San Diego Zoo and Wild Animal Park, and the WCS (Wildlife Conservation Society) network that includes the Bronx Zoo, three other New York City zoos and an aquarium.
One of such networks is Zoo Net, Tokyo's zoological network. The vertical zoo is situated in very dense and very active Shibuya Ward, in Tokyo. Zoo Net includes five other zoo institutions:

- a traditional zoo
- a regional zoo
- an aquarium
- and two endangered species zoos.

Zoo Net is active in preservation and conservation efforts with other zoos worldwide. The vertical zoo is the new urban component for Zoo Net, much like the Bronx, London, or San Diego Zoos.
The future of the network: the vertical zoo

The vertical zoo is a new zoo typology intended to function alongside other zoological institutions in a zoo network.

The vertical zoo rethinks the immersion exhibits spatial orientation and the relationships between various exhibits by stacking the exhibits and exhibit groups vertically.

Taking advantage of vertical space enables the zoo to maintain an urban site, which is important for visitor accessibility and crucial for a continued zoo presence in the city.

By enclosing immersion exhibits in an indoor setting, the zoo is able to recreate the many varied animal environments more accurately.

With the addition of the vertical zoo, a zoological network can redistribute its program more advantageously, improving exhibit space in all of the zoological institutions within the network.
Vertical zoo site

proposed site
Miyashita Park

Shibuya ward
Scramble Crossing
Shibuya Station

Tokyo Zoological Network
OHSHIMA ISLAND
TOKYO
Programmatic organization

The vertical stacking of the immersion exhibits is a more efficient spatial model. Although the vertical zoo’s site is only 2.4 acres, 80% of the vertical zoo’s area is dedicated to exhibit space. This can be compared to traditional zoos where exhibit space is typically around 10% of the total site area.

Vertical stacking of the immersion exhibits is also more energy efficient, taking advantage of heat rising and water falling. To this effect the exhibit program is organized according to bioclimatic zone. The immersion zones are then stacked in terms of the needs for more or less heat, more or less water, and more or less light. For example, in the vertical zoo, the Montane and Tundra bioclimatic zones that require cooler temperatures and less light are at the bottom of the tower, while the Desert Chaparral zone that requires significantly more light, much warmer ambient temperatures, and less water is at the top.
Program is arranged according to species

BIOCLIMATIC ZONE of origin.

Bioclimatic zone stacking is more energy efficient, taking advantage of the properties of heat rising and gravity's pull downwards on water.
Structural organization

The bioclimatic zones are supported by a system of distributed structural cores that continue to different heights through the building and accommodate the different loading conditions and diverse spatial configurations of the various climatic zones. These cores utilize a dynagrid structure, a dynamic grid not uniform in aperture, to create super columns. These super columns require less structural steel, can more adequately support uneven loading conditions, and enable more light to move unimpeded into the building. Additionally, these cores enclose the intense mechanical support the zoo program requires. Further, the dynagrid of these cores branches out to help form the framework for the secondary structure that directly supports the exhibit armature and visitor circulation.
The cores utilize a dynagrid structure, a dynamic grid not uniform in aperture, to create super columns. These columns travel to different heights through the building and at moments, branch out to form the secondary structure that directly supports the exhibit platforms and the circulation.
Circulation
The zoo program requires multiple threads of circulation to occur and interact simultaneously. To accomplish this, the vertical zoo utilizes a circulation system consisting of a fast primary element and a slow secondary element. The primary circulation routes occur in tandem with the distributed structural cores. Each of these cores supports an elevator bank that ascends to different levels within the tower. These cores move people quickly to any of two types of destinations within the tower: transfer floors or intermediate floors.

Transfer floors are distinct from the bioclimatic zones and house the non-exhibit program of the zoo. These floors function as lobbies and support space. Here can be found cafés and retail boutiques, as well as staff administrative offices, education space and related facilities.

Intermediate floors are much smaller and are located within the bioclimatic immersion zones. These floors serve as launching platforms from which visitors move directly into a bioclimatic zone.

The secondary circulation route is accessible from both the transfer floors and the intermediate floors and consists of a series of catwalks, ramps, stairs, and escalators that move visitors among and through the immersion exhibits within the bioclimatic zones. Accessible from the secondary circulation are viewing platforms and short paths that take advantage of the vertical orientation of the space and enable visitors viewing vantage points that are typically not found in traditional zoos.
The structure and primary circulation are combined in 9 mega columns that ascend to different heights through the tower.

Within each dynagird mega column is an elevator bank that functions as part of the primary circulation core.

The secondary circulation is a one way path that winds downwards through each of the biodimate zones, with entrance and exit points at each of the three transfer floors and the small intermediate platforms that occur at the upper termination point of each elevator.
Exhibit plates
The exhibit platforms act as framework for the groundwork and vegetation that will later fill out the exhibit space. Conceived as plates that overlay a steel skeletal frame, exhibit platforms may become deep to create steep slopes for what will become mountainous terrain, as seen in the Montane bioclimate zone, or diversely may be thin with upturned edges acting as shallow trays to eventually hold soft ground matter like sand or mud. Exhibit platforms are not designed to be specific to an animal inhabitant, but rather to provide a substrate that can support the bioclimatic zone and the conditions typical to that zone in which it is located.
The exhibit platforms are contained by a double layer skin consisting of a glass exterior and wire mesh interior. This skin regulates the interior environment, as well as to determine what can be seen from within the exhibits looking out, and from outside looking into the tower. These conditions are achieved by alternating the arrangement of the glass and mesh components of the skin or by completely removing one of the components, such as the glass, leaving only a mesh exterior. Inoperable skin occurs in climatic zones that are incompatible with Tokyo's native environment, such as the Desert Chaparral zone. Operable skin occurs in climatic zones that are maintainable with exposure to Tokyo's climate. In the zones where the skin is operable, the exterior of the skin would require more technical support, and the skin's armature would appear heavier when viewed from within the inside. In certain zones the glazing of the skin will pull in entirely, leaving only the mesh along the surface of the tower.
Project boards

The vertical zoo is a new zoo typology that rethinks the spatial orientation of the immersion exhibit within the individual exhibit and between the groups of exhibits, the bioclimatic zones. By stacking the exhibits vertically, the zoo program is more efficient, taking advantage of the movement of heat, water, and light to guide bioclimatic zone organization - pushing exhibit organization in a new direction. The verticality of the vertical zoo tower enables the zoo program to become a more visual presence in an already dense urban environment.
The history of the zoo: 3 exhibit types

1. Elevational Exhibit

2. Pergola Exhibit

3. Sensation Exhibit

Exhibit typology boards. Original dimensions 24" x 36"
from bottom to top: site board, section board, plans board. Original dimensions 96" x 36".
Site board.
Section board.
Plans board.
Shibuya skyline and vertical zoo. Original dimensions 20” x 36”.
Tower overall dimensions 56" x 36".
Tropical rainforest bioclimate. Original dimensions 36" x 48"
Final model. 1" = 50' scale. Original dimensions base 36" x 48".
Final presentation January 11, 2007. Photo by Richard Hofstede
Research boards
The tower + the zoo

STRUCTURE

CIRCULATION

GROUND CONDITION
The Bronx Zoo is one of the largest zoos in the world, located in New York City. It is named after the Bronx River that runs through the area. The zoo covers 265 acres and is home to over 6,000 animals representing more than 660 species. It is known for its conservation efforts and its role in wildlife protection. The zoo's mission is to conserve wildlife and inspire people to protect it. The Bronx Zoo is a leader in conservation and education, and it offers a variety of educational programs for visitors of all ages. It is a popular tourist attraction and a valuable resource for the scientific community.
SeaWorld

ENTERTAINMENT EDUCATION RESEARCH CONSERVATION

With more than 20 million visitors since opening in March 1964, SeaWorld is San Diego's number one tourist destination and one of the top visitor attractions in the world. The following pages explore the educational, entertainment, research, and conservation aspects of SeaWorld San Diego with a focus on the variety of exhibits, species, and conservation initiatives.

195 acres

- 70% of the exhibits are themed
- 25% are positioned along the perimeter
- 10% are distributed horizontally throughout the interior
- 32% of the exhibits are enclosed
- 36% of the exhibits are part of the existing San Diego program
- 64% of the exhibits are part of the new SeaWorld program

SeaWorld, SD

Mission Beach

Mission Bay

The San Diego SeaWorld is located on Shelter Island near the center of the City of San Diego. The facility's design and layout are inspired by the ocean, with the entire park divided into themed areas.
London Zoo

Entertainment Education Research Conservation

The London Zoo is operated by the Zoological Society of London, which is dedicated to the conservation of wildlife and its habitats. The Zoo's mission is to provide the public with an understanding of animals and their environment. It aims to promote the conservation of wildlife and its habitats through education and research.

The London Zoo is located in Regent's Park, London, England. It is a leading institution in the field of wildlife conservation and offers a range of exhibits and activities for visitors of all ages.

The Zoo covers 36 acres and features 18 soccer fields. A network of circulation paths distributes exhibits by species type and is undirected, 2-way routes.

The London Zoo is a major educational and research facility, and its success is measured by the effectiveness of its education programs and the impact of its research efforts.

Table: London Zoo Information

<table>
<thead>
<tr>
<th>Number of Species</th>
<th>Number of Habitats</th>
<th>Number of Visitor Days</th>
<th>Number of Visitors</th>
<th>Number of Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,000</td>
<td>150</td>
<td>1,000,000</td>
<td>1,500,000</td>
<td>500</td>
</tr>
</tbody>
</table>

The London Zoo is connected to Regents Park by a series of paths, providing a seamless experience for visitors.

Legend:
- London Zoo
- Regents Park
- Marylebone

The London Zoo is a world-renowned institution, dedicated to the conservation of wildlife and its habitats, and it continues to play a vital role in the global effort to protect and preserve the natural world.
Los Angeles Zoo

ENTERTAINMENT  EDUCATION

CONSERVATION

The Los Angeles Zoo is committed to providing an entertaining and educational environment for the enjoyment of its visitors. The zoo participates in conservation programs and works towards preserving natural habitats.

Los Angeles Zoo is located in Los Angeles, California. It covers an area of 113 acres. The zoo houses a variety of animals and plants from different ecosystems.

- The zoo has approximately 57 soccer fields.
- The area of the zoo is approximately 85% less.
- The Los Angeles Zoo follows no organizational logic.
- The Los Angeles Zoo is organized using linear circulation paths.
- The Los Angeles Zoo exhibits are undirected 2-way routes.
- Of the Los Angeles Zoo, approximately:
  - 5% of the exhibits are themed.
  - 88% of the exhibits have eccentricity from the perimeter.
  - 4% of the exhibits are near the interior.
  - 48% of the exhibits are endorsed.

The Los Angeles Zoo is located within Griffith Park, providing visitors with a natural setting for their experience.

The zoo participates in various conservation efforts, contributing to the protection of endangered species and their habitats.
La Ménagerie du Jardin des Plantes

ENTERTAINMENT

La Ménagerie du Jardin des Plantes occupies the western part of the public park of the Paris-Palmyre area, on the left bank of the Seine River. The area is rectangular and is bordered by the avenues of the first and second arrondissements. The main access to the park is from the Place de la Concorde.

The park covers an area of 136.5 acres, including the 7 soccer fields and the network of circulation paths. It is divided into several sections, each featuring a different theme. The exhibits are distributed by species type, and there are undirected, two-way routes throughout the park.

The exhibits are approximately 63% covered by the elevation, 17% by the perimeter, and 0% of the interior are covered by the perimeter. Approximately 22% of the exhibits are enclosed, and 45% of the exhibits are open to the public.

The park is accessible by the 5th arrondissement, and the entrance is located at the Place de la Concorde.
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Le Ménagerie du Jardin des Plantes
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